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BIOLOGICAL EVALUATION OF MORTALITY IN DOUGLAS-FIR PLANTATIONS ON FRENCH HILL, GASQUET RANGER DISTRICT, SIX RIVERS NATIONAL FOREST

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ABSTRACT

Four plantations on French Hill, Gasquet Ranger District, Six Rivers National Forest, were surveyed to determine the amount of black stain root disease in each plantation and to compare the effects of precommercial thinning. Three of the plantations, French Hill F3, E5 (thinned), and E5 (unthinned), had black stain root disease involved in mortality of Douglas-fir. The area with root disease ranged from 0 to 4% of each plantation. The number of root disease centers and their average size in each plantation were 6 (0.09 ac), 16 (0.03 ac), 0 (0.0 ac), and 67 (0.004 ac) for F3, E5 (thinned), E4, and E5 (unthinned), respectively.

INTRODUCTION

During 1984, Forest Pest Management surveyed a sample of Douglas-fir plantations for mortality and its causes on the Gasquet Ranger District, Six Rivers National Forest (see FPM Report No. 85-8). Mortality was not detected on the survey plots, but it was observed outside of the plots. All of the observed mortality involved black stain root disease, caused by Ceratocystis wageneri. A more intensive survey of three plantations on French Hill was done in 1985.

The objectives of the survey were to:

1) Determine the incidence of black stain root disease in the selected plantations.

2) Compare the incidence of black stain root disease in thinned vs. unthinned plantations.

PROCEDURE

The plantations surveyed during the week of May 13, 1985 included French Hill E5, French Hill F3, and French Hill E4. Primary reasons for selecting these plantations were the amount of mortality observed in or near them previously and their similar silvicultural treatment histories. Plantations E5 and F3 had had part of their area precommercially thinned in 1981. Only the thinned portion of F3 was surveyed, while both the thinned and unthinned parts of E5 were surveyed as separate plantations. E4 had not been thinned; therefore, two thinned and two unthinned plantations were surveyed.

The survey methodology used was a transect line sampling system[1]. This method consisted of a 30-foot-wide strip centered on a series of transects that crossed each plantation. The first transect passed through a randomly selected point on a baseline perpendicular to the transects. Subsequent transects were systematically spaced. This methodology provided information on the total area of root disease, the number of root disease centers, and the average size of a center for each plantation.

PEST BIOLOGY

Black Stain Root Disease

Black stain root disease is caused by the fungus Ceratocystis wageneri (asexual state Verticicladiella wageneri). In California, the fungus has three host-specific strains that infect either ponderosa and Jeffrey pine, singleleaf pinyon pine, or Douglas-fir. In most situations, the fungus does not cross-over between species, even in mixed species stands.

Initiation of disease centers probably occurs when spore-carrying, cambium-feeding beetles invade tree roots. These beetles feed on and invade tree roots, whereupon they transmit the spores of the fungus to the tree. The fungus then grows in the wood of the root toward the root collar.

Once the fungus becomes established, it spreads locally between trees. Between-tree transmission is through rootlet contact or fungus growth through the soil for short distances and direct infection of small feeder roots. The rate of underground spread in a ponderosa pine stand is highly variable and dependent on species composition, stand density, and site; on the Georgetown Divide, El Dorado County, the average annual radial spread was 4 feet (range 0 to 20 feet). The rate is not substantiated for Douglas-fir, although it appears to be faster than in pine.

The disease can be identified in a tree by the dark brown to black stain of the wood. This stain occurs as arcs that correspond with the annual rings. The stain may occupy very little to most of the circumference of the tree and may be from one to many annual rings deep.

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[1]Bloomberg, W.J., P.M. Cumberbirch, and G.W. Wallis. 1980. A ground survey method for estimating loss caused by Phellinus weirii root rot. II. Survey procedures and data analysis. Can. For. Serv. Rept. BC-R-4, 44p.

Infected trees undergo gradual to rapid crown decline prior to mortality. Symptoms of crown decline include reduced terminal growth, needle yellowing and shortening, and premature loss of foliage. Trees pole-size and larger may also bear a heavy cone crop. Bark and engraver beetles can successfully attack and kill infected trees. Douglas-firs may have grayish-blue resin streaming from the bark above the stained area.

Little information is available on stand and site characteristics associated with the disease. A characteristic of the disease in Douglas-fir is its higher incidence along roads and in young plantations or dense natural regeneration.

RESULTS

Mortality was detected in all of the plantations, except E4. The dead trees were all within black stain root disease centers. The number of root disease centers and the average size of each center varied considerably between the four plantations (Table 1). However, in the infected stands, the proportions of area of each plantation infested by root disease are similar and represent a relatively small amount of each plantation.

Most of the centers were associated with site disturbances. Only in F3 were root disease centers not associated with a road or skid trail. In this plantation the centers were located in one area approximately 6 to 8 chains south of Road 17N40A. No site disturbance other than site preparation was evident. In both portions of French Hill E5 an old haul road runs along the length of the plantation with a skid trail from the road going through the unthinned portion. Almost all of the observed infection centers in this plantation, both thinned and unthinned sections, occurred in the vicinity of this road and trail. Two separate, single dead trees were found beyond what was considered the influence of these disturbances. This same road, however, continued along E4 where no root disease was seen.

TABLE 1. Incidence of Black Stain Root Disease in Douglas-fir Plantations on the Gasquet Ranger District, Six Rivers National Forest.

	E5 (thinned)	F3 (thinned)	E5 (unthinned)	E4 (unthinned)
Number of Centers	15.9	6.05	66.8	0
Area of Centers (ac)	0.49	0.55	0.24	0
% of Stand Area Infected	4	2	1	0
Average Center Size (ac)	0.03	0.09	0.004	0

DISCUSSION

As was observed during the surveys of 1984, only limited areas of these plantations are being affected by black stain root disease. Except for a few instances, these were limited to areas of site disturbance. Less than 2% of the area of the 4 plantations were involved. This does not significantly affect the productivity of these plantations at this time. However, the plantations should be periodically monitored to determine if additional centers have originated and if the existing centers are continuing to enlarge. If additional plantation acreage does become impacted by the disease then alternative management strategies may be required and need to be devised.

A relationship between thinning and black stain root disease in Douglas-fir did appear to exist in the plantations examined in 1984 and 1985. In stands with certain unknown characteristics, the activity of C. wageneri may be accelerated by thinning activities. The size of centers was considerably larger in thinned stands. An explanation may be the increased food base in the form of stumps and roots for potential vectors. These stump systems may be attractive to the root-feeding vectors of the fungus. The two suspected principal vectors, Hylastes nigrinus and Steremnius carinatus, attack and breed in the roots of fresh stumps and dead and dying trees. S. carinatus is flightless and usually travels no more than 200 feet from its point of emergence. Flight distance of H. nigrinus is not known. Both of these insects appear to be attracted to the roots of freshly cut stumps. These insects may be present in small, established disease centers and readily move outward short distances into surrounding roots of freshly cut stumps. This could increase the rate of enlargement of disease centers beyond the rate of underground spread of the fungus.

The suspected relationship does not necessarily suggest that thinning causes the initiation of black stain root disease centers. Only in certain stands where C. wageneri is established prior to thinning does it appear that there is an increase in disease activity shortly after thinning. Also, this increase does not occur in every situation.

The above information agrees with findings from Oregon and Washington where there are similar situations. This information does not suggest that precommercial thinning activities should be discontinued because of black stain root disease. If an unthinned stand has significant losses to black stain root disease, it may not be advisable to thin because of the existing losses, the possibility of low stocking levels, and the amount of inoculum for increased spread by the vectors. In most stands with no or little effects from the disease, thinning activities should continue as planned acccording to silvicultural requirements.

Forest Pest Management will continue to monitor this situation as additional plantations are regenerated and thinned. FPM personnel are available to examine any plantation or stand at the request of the Forest where they need additional site-specific assistance.